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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

VINH, LAN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 12/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/769,812

Applicant(s)

LIN ET AL.

Examiner

Lan Vinh

Art Unit

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-- Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 16 December 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,4-11 and 13-29 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 11 and 13-18 is/are allowed.
- 6) ☒ Claim(s) 1,4-10 and 19-29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 5, 6, 8, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529) in view of Ye et al (US 6,458,516 )

Ye ( 529) discloses a method for etching patterned layer useful as masking for damascene structure. This method comprises the step of:

forming an organic low k dielectric layer 404 (polyarylene ether ) over a substrate ( col 21, lines 44-45 )

forming a patterned hard mask layer 402 over low k dielectric layer 404, the layer 402 having openings ( col 21, lines 44-45; fig.4A)

etching the low k dielectric layer 404 through the openings on the masking/resist pattern 402 using an etch process to form via 405/first opening, the etch process is conducted by applying bias plasma power to  $\text{NH}_3$  gas in the chamber (col 22, lines 39-42, fig. 4B )

Ye (529) differs from the instant claimed invention as per claim 1 by etching the organic low k dielectric layer by plasma etching using  $\text{NH}_3$  gas instead of plasma etching using  $\text{NH}_3$  and  $\text{O}_2$ .

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However, Ye (516), in a method for etching dielectric, teaches that an organic material such as FLARE (polyarylene ether) can be patterned/etched by a plasma mixture of  $\text{NH}_3$  and  $\text{O}_2$ . (col 22, lines 12-14 )

Since Ye (529) discloses the step of etching the organic low k dielectric layer 404, one skilled in the art would have found it obvious to modify Ye (529) etching step by using a etching mixture of  $\text{NH}_3$  and  $\text{O}_2$  as per Ye (516) because according to Ye (516) a etching mixture of  $\text{NH}_3$  and  $\text{O}_2$  is a required etchant for etching organic dielectric material.

Regarding claims 5-6, 8, Ye (529) discloses that low k dielectric layer 404 made of polyarylene ether ( col 21, lines 48-50 )

Regarding claim 10, Ye (529 ) discloses substrate 408 is made of aluminum/microelectronics conductor material.

3. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ye et al (US 6,458,516 ) and further in view of Bhardwaj et al (US 6,051,503).

Ye (529) as modified by Ye (516) has been described above in paragraph 2. Although Ye (529) discloses flowing 70 sccm of  $\text{NH}_3$  gas (overlaps the claimed range of 50-300 sccm ) and oxygen gas into the chamber at subatmospheric pressure while applying plasma power(col 12, lines 20-21; col 22, lines 41-42 ), Ye (529) and Ye (516) do not disclose the specific values of the plasma density, power and pressure as recited in claim 2.

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However, Bhardwaj, in a method of surface treatment using plasma, teaches that plasma density, plasma power and chamber pressure are parameters that can be varied to change the etch rate (col 2, lines 10-16 )

Hence, one skilled in the art would have found it obvious to modify Ye (529) and Ye (516) by varying the process parameters in view of Bhardwaj's teaching through routine experimentation to obtain particular values in order to achieve desirable etch rate. Also, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)

4. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ye et al (US 6,458,516 ) and further in view of Naik et al (US 6,245,662 )

Ye (529) as modified by Ye (516) has been described above in paragraph 2. Ye (529 ) and Ye (516) differ from the instant claimed invention as per claim 7 by forming a low k dielectric layer of polyarylene ether instead of carbon doped oxide.

However, Naik, in a method for forming interconnect structure, teaches that polyarylene ether or carbon doped oxide (Black diamond ) can be used as low k dielectric material in an interconnect structure ( col 3, lines 51-60 )

Hence, one skilled in the art would have found it obvious to substitute Ye (529) and Ye (516) polyarylene ether low k dielectric layer with carbon doped oxide in view of Naik's teaching because both materials are known low k dielectric materials, thus the substitution of one for the other would have produced an expected result.

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5. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ye et al (US 6,458,516 ) and further in view of Bhardwaj et al (US 6,051,503) and McReynolds (US 6,191,043 )

Ye (529) and Ye (516) and Bhardwaj has been described above in paragraph 3. Unlike the instant claimed invention as per claim 9, Ye (529), Ye (516) and Bhardwaj do not specifically disclose forming a first opening through the low k dielectric layer, the opening having sidewalls that are substantially vertical at a angle between 87-93 degree to the surface of the substrate although Ye (529) discloses forming contact via/opening 405 through the low k dielectric layer 404.

However, McReynolds discloses a method for etching a silicon layer comprises the step of the using plasma etching to etch an opening having sidewalls at a angle between 87 degree to the surface of the substrate (col 3, lines 20-22 )

Hence, one skilled in the art would have found it obvious to modify Ye (529) and Ye (516 ) and Bhardwaj by etching an opening having sidewalls at a angle of 87 degree to the surface of the substrate as taught by McReynolds because McReynolds teaches that opening having straight vertical profile (sidewalls at a angle of 87) has no problematic characteristics such as the bowed features that result from undercutting the hard mask ( col 5, lines 30-33 )

6. Claims 19, 22-24, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 )

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Ye discloses a method for etching patterned layer useful as masking for damascene structure. This method comprises the step of:

forming an organic low k dielectric layer 404 (polyarylene ether ) over an insulating layer 406 over a substrate ( col 21, lines 44-47 )

forming a patterned hard mask layer 402 over low k dielectric layer 404, the layer 402 having openings ( col 21, lines 44-45; fig.4A)

etching the low k dielectric layer 404 through the openings on the masking/resist pattern 402 using an etch process to form via 405/first opening, the etch process is conducted by applying bias plasma power to  $\text{NH}_3$  gas in the chamber (col 22, lines 39-42 )

Unlike the instant claimed invention as per claim 19, Ye fails to disclose flowing only  $\text{NH}_3$  gas and  $\text{N}_2$  to etch the organic low k dielectric layer.

However, Ngo discloses a method for treating/etching semiconductor structure comprises the step of etching a low k dielectric layer using  $\text{NH}_3$  and  $\text{N}_2$  plasma (col 4, lines 40-42 )

Hence, one skilled in the art would have found it obvious to modify Ye's step of etching the low k dielectric layer by etching a low k dielectric layer using  $\text{NH}_3$  and  $\text{N}_2$  plasma as per Ngo because Ngo states that  $\text{NH}_3$ /  $\text{N}_2$  plasma substantially prevents or significantly reduces degradation such that the dielectric constant, shrinkage do not undergo a change in excess of 3% ( col 4, lines 43-47 )

Regarding claims 22-23, 25, Ye discloses that low k dielectric layer 404 made of polyarylene ether ( col 21, lines 48-50 )

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The limitation of claim 24 has been discussed above in paragraph 4.

7. Claims 20-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 ) and further in view of Bhardwaj et al (US 6,051,503).

Ye as modified by Ngo has been described above in paragraph 6. Although Ye (529) discloses flowing 70 sccm of  $\text{NH}_3$  gas (overlaps the claimed range of 50-300 sccm ) and oxygen gas into the chamber at subatmospheric pressure while applying plasma power (col 12, lines 20-21; col 22, lines 41-42 ), Ye and Ngo do not disclose the specific values of the plasma density, power and pressure as recited in claims 20, 21.

However, Bhardwaj, in a method of surface treatment using plasma, teaches that plasma density, plasma power and chamber pressure are parameters that can be varied to change the etch rate (col 2, lines 10-16 )

Hence, one skilled in the art would have found it obvious to modify Yeng and Ngo method by varying the process parameters in view of Bhardwaj's teaching through routine experimentation to obtain particular values in order to achieve desirable etch rate. Also, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)



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8. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 ) and further in view of 6,080,529 ) in view of McReynolds (US 6,191,043 )

Ye method as modified by Ngo has been described above in paragraph 7. Unlike the instant claimed inventions as per claim 26, Ye and Ngo not specifically disclose forming a first opening through the low k dielectric layer, the opening having sidewalls that are substantially vertical at an angle between 87-93 degree to the surface of the substrate although Ye discloses forming contact via/opening 405 through the low k dielectric layer 404.

However, McReynolds discloses a method for etching a silicon layer comprises the step of the using plasma etching to etch an opening having sidewalls at a angle between 87 degree to the surface of the substrate (col 3, lines 20-22 )

Hence, one skilled in the art would have found it obvious to modify Ye and Ngo method by etching an opening having sidewalls at a angle of 87 degree to the surface of the substrate as taught by McReynolds because McReynolds teaches that opening having straight vertical profile (sidewalls at a angle of 87) has no problematic characteristics such as the bowed features that result from undercutting the hard mask ( col 5, lines 30-33 )

9. Claims 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 ) and further in view of Ye et al (US 6,458,516 ).

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Ye (529) method as modified by Ngo has been described above in paragraph 7. Regarding claim 27, Ye (529) discloses that the organic low k dielectric layer can be polyimide (col 23, lines 20-21 ) which reads on an organic spin-on material.

Ye (529) and Ngo differ from the instant claimed invention as per claim 27 by etching the organic low k dielectric layer by plasma etching using  $\text{NH}_3$  gas and  $\text{N}_2$  gas instead of plasma etching gase of  $\text{NH}_3$  and  $\text{N}_2$  and  $\text{O}_2$ .

However, Ye (516), in a method for etching dielectric, teaches that an organic material such as FLARE (polyarylene ether) can be patterned/etched by a plasma mixture of  $\text{NH}_3$  and  $\text{N}_2$  and  $\text{O}_2$ . (col 22, lines 12-14 )

Since Ye (529) discloses the step of etching the organic low k dielectric layer 404, one skilled in the art would have found it obvious to modify Ye (529) etching step by using a etching mixture of  $\text{NH}_3$  and  $\text{N}_2$  and  $\text{O}_2$  as per Ye (516) because according to Ye (516) a etching mixture of  $\text{NH}_3$  and  $\text{N}_2$  and  $\text{O}_2$  is a required etchant for etching organic dielectric material.

### ***Allowable Subject Matter***

10. Claims 11, 13-18 are allowed.

The following is an examiner's statement of reasons for allowance:

The cited prior art of record fails to disclose the step of etching the organic low k dielectric layer by gaseous plasma etching using  $\text{NH}_3$  and  $\text{H}_2$  and  $\text{O}_2/\text{CO}$ . The closest prior art of Ye et al (US 6,458,516 ) suggests etching the organic low k dielectric layer by gaseous plasma etching using  $\text{NH}_3$  and  $\text{N}_2$  and  $\text{O}_2$

***Response to Arguments***

11. Applicant's arguments with respect to claims 1, 4-10 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's arguments filed 12/16/2002 with respect to the rejection of claims 19, 22-24, 25 have been fully considered but they are not persuasive.

In response to applicant's argument that there is no suggestion to combine the references of Ye (529) and Ngo because Ngo does not form an opening, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, since Ngo teaches the claimed gas mixture of  $\text{NH}_3$  and  $\text{N}_2$  and the motivation come from Ngo (paragraph 6), one skilled in the art would have found it obvious to incorporate Ngo teaching into Ye (529) method to produce the claimed invention.

In response to applicant's argument that the examiner's conclusion of obviousness to combine Ye (529) and Bhardwaj based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a

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reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.


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***Conclusion***

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

LV  
December 23, 2002



**ROBERT KUNEMUND  
PRIMARY EXAMINER**